TABLE 1

CONSTANTS FOR THE SIX DISTANCES GIVEN IN FIGURE I FOR THE "PURE LINE" IN RAT 105 ON THE 25TH DAY OF BLOOD INFECTION. THE MEANS AND STANDARD DEVIATIONS ARE IN MICRONS

	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
Post-Para	4.268 ± .036	.544 ± .025	12.74 ± .61
Para-Nuc	10.854 ± .016	.240 ± .011	2.21 ± .10
Nuc-Ant	9.511 ± .047	.704 ± .033	7.41 ± .35
Ant-End	6.619 ± .068	1.010 ± .048	15.27 ± .74
T. Length	31.251 ± .059	.875 ± .041	2.80 ± .13
Width	1.590 ± .015	.230 ± .010	14.47 ± .70

[1] This and a later report form a preliminary account of a series of investigations which are being carried out in this laboratory on variation and inheritance in T. lewisi.

[2] Throughout this work the term "pure line" infection has been used to designate an infection, the trypanosomes of which have all arisen from a single organism. A given "pure line" may either have been started from a single specimen or it may have been subinoculated from such an infection.

[3] See especially Jennings, H. S., *Proc. American Phil. Soc.*, **47**, 1908 (393–546). *American Nat.*, **43**, 1909 (321–337). *Ibid.*, **45**, 1911 (79–89).

MEASUREMENT OF THE DIAMETER OF ALPHA-ORIONIS BY THE INTERFEROMETER

BY A. A. MICHELSON AND F. G. PEASE

MOUNT WILSON OBSERVATORY, CARNEGIE INSTITUTION OF WASHINGTON

Communicated March 12, 1921

It was shown in these PROCEEDINGS[1] that in the application of interference methods to astronomical measures, the fringes show no decrease in visibility with the slits separated by the full aperture of the 100-inch Hooker telescope even when the seeing is poor. It was therefore decided to build an interferometer with movable outer mirrors in order to test for separations as great as 20 feet.

The interferometer bed consists of a fabricated steel beam, designed with special regard to lightness and stiffness, mounted on the end of the Cassegrain cage of the 100-inch reflector (fig. 1). Two tracks were planed on the top, true to 0.001 inch (0.025 mm.), the frame being supported on the planer as it was to be mounted on the telescope. On this beam are mounted four slides, each carrying a mirror about 6 inches (152 mm.) in diameter, inclined 45 degrees to the base. The two inner mirrors M_2, M_3, are fixed, 45 inches (114.2 cm.) apart, while those of the outer pair M_1, M_4, are movable and can be separated to a distance of 20 feet (6.1 m.). The light pencils are reflected from the outer to the inner mirrors, thence over the customary path a, b, c, d, in the telescope, and are viewed with an eyepiece at the Cassegrain focus d, where the equivalent focal length is 134 feet (40.8 m.). The fixed position of the inner mirrors gives a constant fringe spacing equal to 0.02 mm., which is easily visible with a power of 1600.

Coincidence of the two interferometer pencils at the focus is produced by adjusting the inner mirrors during the day and the outer mirrors on a star at night. Equality of path is obtained by placing the outer mirrors symmetrically on the beam, as nearly as possible, and then adjusting a double wedge of glass lying two feet within the focus in the path of one of the pencils.

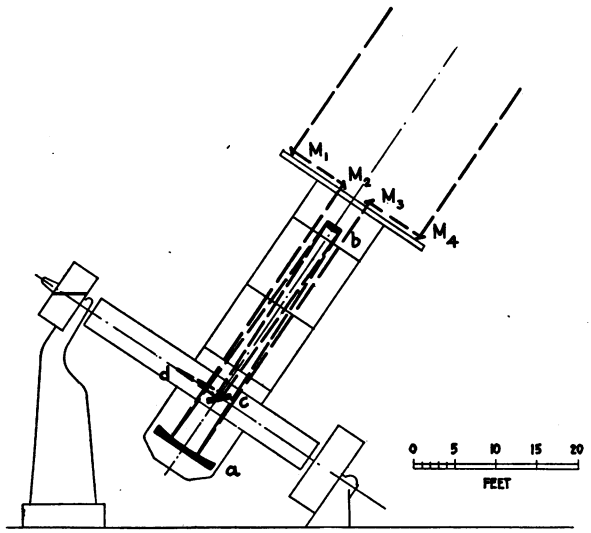

FIG. 1

Compensation for the mean thickness of the wedges is made with a plate of plane-parallel glass placed in the other pencil.

One of the wedges is fixed, the other is adjustable in a direction parallel to the inclined surfaces, a linear motion of 1 millimeter introducing an equivalent air path of about 0.09 mm. Fringes can be observed throughout a linear motion of the wedge amounting to 0.16 mm., corresponding to about 26 light waves. This range can be increased by introducing a direct-vision prism behind the eyepiece.

For comparison purposes a series of reference or "zero" fringes is obtained in the eyepiece by covering the end of the telescope tube completely save for two apertures in the beam (in addition to those of the inner mirrors) 6 inches in diameter.

When the interferometer is in perfect adjustment and the outer mirrors are close together, two separate star images are seen in the eyepiece, one formed by light reflected by the mirrors, the other by light admitted by the supplementary apertures which produce the zero fringes. Each image is surrounded by diffraction rings and crossed by the interference fringes, which appear as straight lines, alternately dark and light, perpendicular to the line joining the mirrors.

As the outer mirrors are separated, the visibility of the zero fringes remains constant, while that of the interferometer fringes gradually decreases until a point is reached where the latter vanish; as the mirrors are further separated the interference fringes should reappear, approach a secondary maximum, and again disappear, this phenomenon being repeated indefinitely.

We are interested chiefly in the first disappearance. The distance between the mirrors corresponding to extinction is the observed quantity required to determine the angular diameter of the star. Thus far it has been necessary to move the mirrors by steps, as screws are only now being installed to maintain the mirrors at equal distances.

The visibility of fringes obtained with the interferometer pointed on Vega in August, 1920, with the mirrors separated 18 feet (5.5 m.), was fully as great as with the mirrors 6 feet (1.83) apart, thus indicating that atmospheric conditions will easily permit the use of even greater separations.

Calculations of stellar diameters based on estimates of surface brightness made by Eddington, Russell, and Shapley, indicated that α Orionis, because of its relatively large diameter, would be a promising object to attempt to measure with the 20-foot interferometer. Merrill first examined the star with the apparatus used by Anderson[2] in the measurement of Capella and found a definite decrease in visibility for the maximum separation of the slits (100 inches). This was true for all position angles, thus indicating that the star was not a binary.

On December 13, 1920, the interferometer was tested by Pease on β Persei and then on γ Orionis. Both stars are known to have diameters much smaller than can be measured with this instrument. When adjusted with the mirrors separated 121 inches (229 cm.), both the zero and the interferometer fringes appeared in the eyepiece. When the instrument was directed to α Orionis the interferometer fringes could not be found. α Canis Minoris was then observed and the interferometer fringes were easily seen thus indicating that the instrument was still in adjustment. It is thus clear that the disappearance of the fringes for α Orionis was real and not due to any disturbance of the mirrors, for the seeing was good and any flexure changes involve only a very slight shift of the compensating wedge to bring the fringes into view again.

On December 14 and the nights following, the seeing was poor and as the visibility of the zero fringes was decidedly lower than on the night of the 13th, no attempt was made to work on α Orionis. With a mirror separation of 13 feet attention was directed to α Ceti, α Tauri and β Geminorum. The zero fringes were seen in every case, though much reduced in visibility, but as the interferometer fringes could not be seen at all except at intervals of better seeing, it is presumed that there was an actual decrease in visibility and that with further observation some estimate can be made of the diameter of these stars.

Assuming that the effective wave-length of α Orionis is 5.75×10^5 cm. and that the value of d is 121 inches (306.5 cm.), the angular diameter of α Orionis from the formula $\alpha = 1.22\frac{\lambda}{d}$ proves to be 0.047. An estimate of its linear diameter may be made by using a mean parallax of 0".018,[3] which gives a diameter of 240×10^6 miles, or slightly less than that of the diameter of the orbit of Mars.

Corrections to this value will be derived by an experimental determination of the value of λ for this particular star; by a more accurate setting of the mirrors, for the uncertainty of this measure is at least 10 per cent; and by further determination of the parallax. The angular value given above is that corresponding to a uniformly illuminated disk. A darkening toward the limb, equal to that of the sun, would require an increase in the diameter of about 17 per cent.

We wish to express our obligations to Director Hale both for his encouragement and for placing the resources of the observatory at our disposal, and to Mr. J. A. Anderson for his checking of the measures on the night of December 13.

[1]These PROCEEDINGS, **6**, 1920 (474–475).

[2]*Mount Wilson Contributions*, No. 185; *Astroph. J. Chicago*, **51**, 1920 (263–275).

[3]The weighted mean of Adam's spectroscopic parallax, 0.012 and the trigonometric parallaxes of Elkin, 0.030, and Schlesinger, 0.016.

AN OVERLOOKED INFINITE SYSTEM OF GROUPS OF ORDER pq^2

By G. A. MILLER

DEPARTMENT OF MATHEMATICS, UNIVERSITY OF ILLINOIS

Communicated April 28, 1921.

The determination of all the possible abstract groups of order pq^2 p and q being distinct prime numbers, was considered by Cole and Glover in an article published in the *American Journal of Mathematics*, vol. 15 (1893), p. 191 and by O. Hölder in a long article published in the *Mathematische Annalen*, vol. 43 (1893), p. 301. In a subsequent article, published in volume 46 of the latter journal, Hölder directed attention in foot-note on page 323 to the fact that the enumeration of these groups contained in the former of the two articles mentioned above was incomplete.

The main object of the present article is to establish the fact that there is an infinite system of abstract groups of order pq^2 which was overlooked not only by the authors already mentioned but also by others, including W. Burnside who gave an incomplete list of these groups in both editions of his well known and meritorious work entitled, "Theory of Groups of